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Size-at-age and condition of cod in Divisions 2J+3KL during 1978-1997

by

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Abstract

The size-at-age and condition of cod in the offshore of Divisions 2J, 3K and 3L were monitored by sampling catches during research bottom-trawl surveys in the autumns of 1978-1997. Mean lengths-at-age and weights-at-age declined over time, with the decline most prominent in Division 2J. There has been some increase in recent years from a minimum in the early 1990s. Condition, as measured by somatic (gutted) weight relative to length cubed, declined dramatically in Division 2J in the early 1990s. There was a small decline in Division 3K and no decline in Division 3L. Condition has improved in Divisions 2J and 3K in recent years. Liver index, measured as liver weight relative to length cubed, declined considerably in Division 2J in the early 1990s and has since recovered somewhat, whereas it increased considerably in Division 3L in the early 1990s and has since declined somewhat. During previous assessments of this stock, weights-at-age at the beginning of the year (January 1) were estimated from the mean weights-at-age derived from sampling of commercial catches. Attention is drawn to several aspects of the commercial weight-at-age matrix, and the beginning of the year weights-at-age were updated for inclusion in the 1998 assessment.

Résumé

La taille selon l'âge et la condition des morues des parties hauturières des divisions 2J, 3K et 3L ont été contrôlées par échantillonnage des captures des relevés de recherche d'automne au chalut de fond de 1978 à 1997. La valeur moyenne de la longueur et du poids selon l'âge a diminué au cours des années, le déclin le plus important étant noté dans la division 2J. Une légère augmentation, par rapport au minimum du début des années 1990, a été notée ces dernières années. La condition, déterminée comme le rapport du poids somatique (poisson éviscéré) à la longueur au cube, a chuté de façon très importante dans la division 2J au début des années 1990. Un léger déclin a été noté en 3K et aucun en 3L. La condition s'est améliorée dans les divisions 2J et 3K au cours des dernières années. L'indice hépatique, déterminé comme le rapport du poids du foie à la longueur au cube, a considérablement diminué en 2J au début des années 1990 et s'est ensuite quelque peu rétabli. Il s'est accru de façon considérable en 3L au début de ces mêmes années, avant de décliner quelque peu. Au cours des évaluations précédentes de ce stock, le poids selon l'âge en début d'année (1er janvier) était estimé à partir du poids moyen selon l'âge obtenu par échantillonnage des captures commerciales. On attire l'attention sur divers aspects de la matrice du poids selon l'âge des captures commerciales et les valeurs en début d'année ont été mises à jour pour inclure dans l'évaluation de 1998.

Introduction

This paper documents changes in size-at-age and condition of cod in Divisions 2J, 3K and 3L, as determined from sampling during bottom-trawl surveys in the offshore during the autumns of 1978-1997. Earlier studies have examined the possible relationship between changes in these biological attributes and changes in stock size, environmental temperature and the stock size of capelin, the most important prey of cod in this area (Akenhead et al. 1982; Wells MS 1984, MS 1986; Millar et al. MS 1990; Millar and Myers MS 1990; Shelton et al. 1991; Bishop and Baird 1994; Shelton and Lilly MS 1995; de Cárdenas 1996; Shelton et al. MS 1996; Krohn et al. 1997; Krohn and Kerr 1997). There is also a possibility that some of the variability in annual means may be caused by small sample sizes and changes in sampling pattern (Lilly MS 1996a). As a prelude to additional study of factors influencing changes in growth and condition of 2J+3KL cod, this paper documents the sample sizes available for calculation of growth and condition and updates the time-series of both size-at-age and condition (Lilly MS 1997).

A second purpose of this paper is to document the method used to obtain approximate January 1 weights-at-age by interpolation from commercial weights-at-age. The January 1 weights-at-age were required as input to the current cod assessment (Lilly et al. MS 1998).

Materials and Methods

Research vessel surveys

Survey design

Cod were caught during random-stratified bottom-trawl surveys designed to assess the biomass of demersal fish during the autumns of 1978-1997 (Lilly MS 1996b). All surveys in Divisions 2J and 3K in 1978-1994 were conducted with the 74 m stern trawler 'Gadus Atlantica'. Surveys in Division 3L in 1981-1983 and 1985-1994 were conducted with the 51 m side trawler 'A. T. Cameron' (1981-1982) and the sister 50 m stern trawlers 'Wilfred Templeman' (1983, 1985, 1987-1994) and 'Alfred Needler' (1986). There were no autumn surveys in Division 3L in 1978-1980 and 1984. The 'Gadus Atlantica', 'Wilfred Templeman' and 'Alfred Needler' deployed an Engel 145 Hi-Lift trawl, whereas the 'A. T. Cameron' deployed a Yankee 41-5 trawl (McCallum and Walsh 1997). The surveys in 1995-1997 differed from those in previous years in several respects (Brodie MS 1996). The 'Gadus Atlantica' was replaced by the 63 m stern trawler 'Teleost', the Engel 145 Hi-Lift trawl was replaced with a Campelen 1800 shrimp trawl with rockhopper foot gear and the 'Wilfred Templeman' fished part of Division 3K. In addition, tows were made at 3.0 knots for 15 min instead of 3.5 knots for 30 min, as had been the case in all years prior to 1995. In all instances, a 29 mm meshliner was inserted in the codend. Fishing in all Divisions and years was conducted on a 24-h basis. The variability in ships and bottom-trawls may have resulted in numerous changes in catching efficiency. The Campelen trawl has been shown to be far more effective at catching small cod than was the Engels Hi-Lift trawl (Warren 1997). The influence that these changes in ships and trawls may have had on estimates of mean lengths- and weights-at-age has not been investigated.

Fishing stations were allocated randomly within strata that had been designed by defining depth zones and then subdividing these zones along lines of latitude or longitude. The number of fishing stations allocated to each stratum was roughly proportional to the size of the stratum, with the constraint that each stratum be allocated no fewer than 2 stations. (There were instances in which the sampling objectives were not realized.) Doubleday (1981) provides illustrations of the strata and information on their areas and depth-ranges. Additions and modifications to the stratification scheme are described by Bishop (MS 1994). The most notable change in survey coverage was the addition of depths between 100 and 200 m in northwestern Division 3K (St. Anthony Shelf and Grey Islands Shelf) in 1984 and subsequent years. Additional strata were added to the inshore in 1996 and 1997. Many analyses of survey data, including sequential population analysis, make use of only those strata that have been fished most consistently since the start of the surveys. These "index" strata exclude the new inshore strata and all strata deeper than 500 m in Divisions 2J and 3K and deeper than 366 m in Division 3L

Biological sampling

Sampling of cod for otoliths and various biological attributes was conducted using two distinct procedures. The first involved determination of biological attributes (eg. fork length, cm) and the extraction of otoliths at sea. The second involved the determination of body length at sea followed by the freezing of the fish for detailed examination in the laboratory at the Northwest Atlantic Fisheries Centre, St. John's. These frozen fish were thawed in fresh water and weighed (to the nearest 10 g) before being cut (round weight) and again after removal of the organs from the abdominal cavity (gutted weight). The liver and gonad were also weighed (g) or measured volumetrically (ml).

For each of these two methods of sampling, there were several changes in what constituted a sample and several changes in the biological attributes measured. These changes have not yet been thoroughly documented, but they were similar to changes in the sampling from research vessel surveys in Subdivision 3Ps (Lilly MS 1998). An important change occurred in 1997 when for the first time all weighings were conducted at sea.

The number of fish sampled for both length and age is reported in Table 1. Sample sizes were relatively high in Division 2J in 1984 and 1985 when the number of frozen fish was increased considerably. Sample sizes declined in all Divisions in the 1990s as catches rapidly declined. The increase in sample sizes for the younger ages (especially ages 1-3) in 1995-1997 reflects the change to the Campelen trawl. The number of fish sampled for length, age and round weight is reported in Table 2. There was a large increase in Division 2J in 1984 and 1985 as noted above. From 1978-1988, sample sizes were generally much smaller for weights than for lengths. This changed in 1989 in Divisions 2J and 3K and in 1990 in Division 3L when balances were first used at sea to obtain round weight, gutted weight, and weights of livers and gonads for all fish sampled at sea. The decline in sample sizes through the 1990s, and the increase in sampling of young fish in 1995-1997, were noted above.

Data analysis

All sampling was stratified by length, so calculation of mean length, weight and condition at age included weighting observations by population abundance of the size groups (Morgan and Hoenig 1997), where the abundances were calculated by areal expansion of the stratified arithmetic mean catch at length per tow (Smith and Somerton 1981). Note that prior to 1989 (1990 in Division 3L) the number of aged fish for which weight was recorded was substantially fewer than the number for which length was recorded.

The somatic condition and liver index of each fish were expressed using Fulton's condition factor ($(W/L^3)*100$), where W is gutted weight (kg) or liver weight (kg) and L is length (cm). Note that somatic condition as defined in this paper differs from that proposed by Dutil et al. (MS 1995), who use somatic weight calculated as total weight minus gonads and stomach contents. This formulation cannot be applied directly to data collected from cod in Divisions 2J, 3K and 3L because the weight of the empty digestive tract was not determined. Note that there may be merit in considering the sizes of the carcass (gutted weight) and the liver separately, since these two body compartments may differ in their responses to food deprivation and intensive feeding. In addition, the liver index used in this paper differs from the hepato-somatic index proposed by Dutil et al. (MS 1995). For the liver index in this paper the liver weight is expressed relative to body length, in a manner identical to the calculation of somatic condition, whereas for the hepato-somatic index of Dutil et al. (MS 1995) the liver weight is expressed relative to somatic weight. A concern with the latter formulation is that body components other than the liver may vary in weight. Hence, for a fish of given length, changes in muscle mass will cause changes in hepato-somatic index (as defined above) even if there is no change in liver weight.

Results

Size at age

Mean lengths-at-age (Table 3; Fig. 1) and weights-at-age (Table 4; Fig. 2) declined over time, with the decline most prominent in Division 2J and least prominent in Division 3L. These divisional differences are illustrated more clearly in Fig. 3, which focuses on changes in mean lengths and weights of cod of ages 4 and 6. Superimposed on the long-term decline are periods of relatively quicker or slower growth associated with changes in water temperature (Shelton and Lilly MS 1995; Shelton et al. MS 1996). The trend toward very low mean lengths-at-age and weights-at-age in the early 1990s appears to have been reversed, but sample sizes at ages greater than age 4 have been very small in recent years, so the accuracy of these estimates is suspect.

Cod well-being

Average Fulton's condition for cod of ages 2-12 are provided in Tables 5 and 6 for round weights and gutted weights respectively. The gutted values for ages 3-6 are illustrated by Division in

Fig.4. Illustrations for older ages are available in previous reports (eg. Bishop and Baird 1994; Taggart et al. 1994; Bishop et al. MS 1995), and are not provided in the present paper because sample sizes were very small or nil in recent years. The most notable feature of the gutted weight condition index was the dramatic decline in Division 2J in the early 1990s. A similar but less dramatic decline occurred in Division 3K, and there was no consistent change in Division 3L. Condition levels have improved in both Division 2J and Division 3K since the nadir in 1992. Levels continue to fluctuate without trend in Division 3L.

Average liver indices for cod of ages 2-12 are provided in Table 7, and values for ages 3-6 are illustrated by Division in Fig. 5. As described in earlier reports, there was a decline in liver index in Division 2J in the early 1990s, and an increase in liver index in Division 3L at about the same time. There was no change in Division 3K. Since the early 1990s, levels have increased somewhat in Division 2J, remained almost unchanged in Division 3K, and declined somewhat in Division 3L. In Division 2J, the continued low level in the liver index contrasts with the improvement in somatic condition.

Commercial weights-at-age

Mean weights-at-age of the cod caught in the commercial and recreational fisheries and sentinel surveys in Divisions 2J+3KL in 1962-1997 are provided in Lilly et al. (MS 1998). There are several aspects of these data (Table 8; Fig. 6) that should be noted. (1) Constant values have been assumed in some of the early years. Weights at ages 2-20 are constant from 1962 to 1971 and weights at ages 19 and 20 are constant from 1972 to 1977. The value for age 20 jumps from 7.19 kg in the first period to 17.46 in the second. (2) Some values seem unusually high or low compared with adjacent values. The most notable instances are values for ages 8 and 9 in 1993, which seem much too high, and the value for age 12 in 1995, which is too low. It is assumed that these outliers arise from sampling error, often associated with small sample sizes, although there may be other reasons not yet discovered. Values which appear either high or low have not been altered. (3) There are missing values for age 2 and ages 10-20, especially since 1991. Values for age 2 are required for reconstruction of the population biomass and have been set at 0.26 kg, which is the average of non-missing values in the period 1974-1997. Values are required for some of the other missing ages as well, and for consistency have been supplied for all instances. Where possible a missing value was assumed to equal the average of the values in the nearest two non-missing years preceding and two non-missing years following. Where values were not available for following years, values were assumed to be equal to the average of the nearest three preceding non-missing years. The exception to this was age 20 in 1990-1997, which was set equal to the value of the nearest four preceding years because the value for 1988 seemed low compared to the others. The resulting matrix is presented in Table 9.

Weights-at-age at the beginning of the year

Estimation of population biomass at the beginning of the year requires an estimate of the mean weight-at-age at the beginning of the year. These mean weights have in the past been obtained by adjusting to the beginning of the year those mean weights-at-age calculated from sampling during the commercial fishery (see, for example, Rivard 1982, p. 14). A problem with such data

is that the commercial fishery may be conducted with a variety of gears, each with its peculiar selection pattern, and the temporal pattern of fishing may not centre on the time when the fish attains the mid-point of its annual length increment. In addition, both the relative contribution of each gear to the total catch and the temporal and spatial pattern of fishing may vary among years. Prior to preparation of the 1998 assessment of 2J+3KL cod it was thought that weights-at-age derived from sampling during research bottom-trawl surveys might provide a more representative measure of weight-at-age at the beginning of the year. Based on a comparison of data from research surveys and the commercial fishery in Subdivision 3Ps (Lilly MS 1998), it was decided that data from the research vessel survey were too variable at older ages and that it would be prudent to continue to use estimates from commercial fishery data until more representative data were available. The use of survey data for the 2J+3KL stock in recent years is further constrained by the absence in the surveys of some age-groups that have been caught in the inshore fishery. This is most apparent in Divisions 2J and 3K. It was decided that the commercial weights at age would be used in the reconstruction of population size and in the projections.

For the 1998 assessment of 2J+3KL cod, the beginning of the year weights-at-age were required as an input matrix. Weights-at-age at the beginning of the year were calculated from the commercial weights-at-age using formulae in Rivard (1982, p. 14). For ages 3-20, weight-at-age at the beginning of year t ($W_{i,t}$) was approximated by

$$W_{i,t} = e^{(\ln W_{i-0.5,t-0.5} + \ln W_{i+0.5,t+0.5})/2}$$

For age 2, the $W_{i,t}$ were approximated by the relationship

$$W_{i,t} = e^{(2\ln W_{i+0.5,t+0.5} - \ln W_{i+1,t+1})}$$

The resultant matrix is presented in Table 10.

In addition, exploration of the consequences of various catch options in 1998 requires estimates of the weights-at-age in the commercial catch in 1998 and weights-at-age in the population at the beginning of 1998 and 1999. It was assumed that the mean weights-at-age in the 1997 fishery would provide the best estimates of the mean weights-at-age in the 1998 fishery. Mean weights at ages 3-20 at the beginning of 1998 were then estimated as for earlier years. The mean weight for age 2 at the beginning of 1998 was assumed to be the same as the mean weight for age 3 at the beginning of 1997. All mean weights-at-age at the beginning of 1999 were assumed to be unchanged from mean weights-at-age at the beginning of 1998. The assumed values are added to Table 10.

Discussion

This paper has simply documented some of the variability in size and condition of cod in Divisions 2J, 3K and 3L on various temporal and spatial scales. There is no new analysis. Several studies (see Introduction) have explored the extent to which annual variability in the size and condition of cod in Divisions 2J, 3K and 3L is correlated with variability in stock size, environmental temperature, and the stock size of capelin, the cod's most important prey. While there is evidence that stock size, temperature and capelin have had an effect, the various studies have not provided sufficient explanation for the changes which have been observed. None have adequately explained why the temporal pattern of change in growth, somatic condition and liver index has differed from north to south. Annual temperature anomalies in 2J, 3K and 3L tend to be highly correlated, so why is there Divisional variability in the temporal changes in growth rate? It is thought that there is just one capelin stock in Subarea 2 and Divisions 3K and 3L, so why should growth and condition be correlated with capelin biomass in some Divisions but not in others? Part of the explanation for the Divisional variability in the influence of capelin may lie in annual variability in the extent and duration of overlap between cod and capelin. The overlap will be influenced by changes in distribution patterns and migration timing exhibited by both cod and capelin (Lilly 1994, MS 1995; Frank et al. 1996; Nakashima 1996; Carscadden and Nakashima 1997). Additional study of factors influencing growth and condition of cod in Divisions 2J, 3K and 3L should first determine if an important portion of the observed variability is due to measurement error, associated with changes in survey timing and the way the sampling was conducted, and should then try to determine how individual components of the northern cod stock complex have been influenced by changes in oceanographic factors, such as temperature, and changes in access to prey, particularly capelin.

There may be interest in using the commercial weights-at-age to explore the extent to which growth may have been influenced by factors such as stock abundance, environmental temperature and the abundance or availability of prey, particularly capelin. As noted by Hutchings and Myers (1994), the commercial weights-at-age reveal that the decline seen in the research vessel data should not be interpreted as a decline from historic levels, because the commercial weights-at-age were even lower in the mid-1970s than in the early 1990s. There was a rapid increase from low levels in the early to mid-1970s to a peak in the late 1970s or early 1980s followed by a long decline. These changes must be interpreted with caution. The mean weight for each age and year is calculated from the weights of cod caught in the fishery, and the fishery has itself changed considerably over the period from the early 1970s to the late 1990s (Lilly et al. MS 1998 and references therein). For example, with the extension of jurisdiction in 1977, the non-Canadian trawler fleets were replaced almost entirely by a Canadian fleet. The spatial distribution of the trawler catch has varied over time. There have been changes in the relative contribution of trawler catches, which were taken mainly in the first quarter, and inshore fixed gear catches, which were taken predominantly in the third quarter. The contribution by each of the fixed gears has also changed over time. There appears to have been considerable improvement in commercial weights-at-age since the early 1990s, but this may be due at least in part to major changes in the pattern of fishing. Since declaration of the moratorium in July 1992, most of the catch has come from shallow-water fixed gears in the third quarter, with no contribution from winter fishing, no contribution from trawlers and very little contribution from the north (Division

2J). To date, there has been no attempt to eliminate some of these potentially confounding factors in the estimates of historic weights-at-age by limiting analyses to specific gears, areas and seasons.

References

Akenhead, S.A., Carscadden, J., Lear, H., Lilly, G.R., and Wells, R. 1982. Cod-capelin interactions off northeast Newfoundland and Labrador, p. 141-148. *In* M. C. Mercer [ed.] Multispecies approaches to fisheries management advice. Can. Spec. Publ. Fish. Aquat. Sci. 59.

Bishop, C.A. MS 1994. Revisions and additions to stratification schemes used during research vessel surveys in NAFO Subareas 2 and 3. NAFO SCR Doc. 94/43, Serial No. N2413. 23p.

Bishop, C.A., and Baird, J.W. 1994. Spatial and temporal variability in condition factors of Divisions 2J and 3KL cod (Gadus morhua). NAFO Sci. Coun. Studies 21: 105-113.

Bishop, C.A., Stansbury, D.E., and Murphy, E.F. MS 1995. An update of the stock status of Div. 2J3KL cod. DFO Atl. Fish. Res. Doc. 95/34. 38 p.

Brodie, W. MS 1996. A description of the 1995 fall groundfish survey in Division 2J3KLNO. NAFO SCR Doc. 96/27, Serial No. N2700. 7 p.

Carscadden, J., and Nakashima, B.S. 1997. Abundance and changes in distribution, biology, and behavior of capelin in response to cooler waters of the 1990s. *In* Forage fishes in marine ecosystems. Proceedings of the international symposium on the role of forage fishes in marine ecosystems. University of Alaska Sea Grant College Program. Report No. 97-01.

de Cárdenas, E. 1996. Some considerations about annual growth rate variations in cod stocks. NAFO Sci. Coun. Studies 24: 97-107.

Doubleday, W.G. (ed.) 1981. Manual on groundfish surveys in the Northwest Atlantic. NAFO Sci. Coun. Studies 2: 7-55.

Dutil, J.-D., Lambert, Y., Chouinard, G. A., and Fréchet, A. MS 1995. Fish condition: what should we measure in cod (Gadus morhua)? DFO Atlantic Fisheries Res. Doc. 95/11. 26 p.

Frank, K.T., Carscadden, J.E., and Simon, J.E. 1996. Recent excursions of capelin (Mallotus villosus) to the Scotian Shelf and Flemish Cap during anomalous hydrographic conditions. Can. J. Fish. Aquat. Sci. 53: 1473-1486.

Hutchings, J.A., and Myers, R.A. 1994. What can be learned from the collapse of a renewable resource? Atlantic cod, Gadus morhua, of Newfoundland and Labrador. Can. J. Fish. Aquat. Sci. 51: 2126-2146.

Krohn, M., and Kerr, S. 1997. Declining weight-at-age in northern cod and the potential importance of the early years and size-selective fishing mortality. NAFO Sci. Coun. Studies 29: 43-50.

Krohn, M.M., Reidy, S.P. and Kerr, S.R.. 1997. Bioenergetic analysis of the effects of temperature and prey availability on growth and condition of northern cod (Gadus morhua). Can. J. Fish. Aquat. Sci. 54 (Suppl. 1): 113-121.

Lilly, G.R. 1994. Predation by Atlantic cod on capelin on the southern Labrador and Northeast Newfoundland shelves during a period of changing spatial distributions. ICES mar. Sci. Symp. 198: 600-611.

Lilly, G.R. MS 1995. Did the feeding level of the cod off southern Labrador and eastern Newfoundland decline in the 1990's? DFO Atl. Fish. Res. Doc. 95/74. 25 p.

Lilly, G.R. MS 1996a. Condition of cod in Divisions 2J+3KL during the autumns of 1978-1995. NAFO SCR Doc. 96/48, Serial No. N2723. 15 p.

Lilly, G.R. MS 1996b. By-catches of capelin and Arctic cod during bottom trawl surveys in NAFO Divisions 2J3KL, p. 218-242. In Anon. [ed.] Capelin in SA2 + Div. 3KL. DFO Atlantic Fisheries Research Document 96/90.

Lilly, G.R. MS 1997. Size and condition of cod in Divisions 2J+3KL during 1978-1996. NAFO SCR Doc. 97/62, Serial No. N2896. 21 p.

Lilly, G.R. MS 1998. Size-at-age and condition of cod in Subdivision 3Ps as determined from research bottom-trawl surveys (1972-1997). DFO Can. Stock Assess. Sec. Res. Doc. 98/94. 29 p.

Lilly, G.R., Shelton, P.A., Brattey, J., Cadigan, N., Murphy, E.F., Stansbury, D.E., Davis, M.B., and Morgan, M.J. MS 1998. An assessment of the cod stock in NAFO Divisions 2J+3KL. DFO Can. Stock Assess. Sec. Res. Doc. 98/15. 102 p.

McCallum, B.R., and Walsh, S.J. 1997. Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971-present. NAFO Sci. Coun. Studies 29: 93-104.

Millar, R.B., Fahrig, L., and Shelton, P.A. MS 1990. Effect of capelin biomass on cod growth. ICES C.M. 1990/G:25. 10 p.

Millar, R.B., and Myers, R.A. MS 1990. Modelling environmentally induced change in size at age for Atlantic Canada cod stocks. ICES C.M. 1990/G:24. 13 p. (also CAFSAC Res. Doc. 90/48)

Morgan, M.J., and Hoenig, J.M. 1997. Estimating maturity-at-age from length stratified sampling. J. Northw. Atl. fish. Sci. 21: 51-63.

Nakashima, B.S. 1996. The relationship between oceanographic conditions in the 1990s and changes in spawning behaviour, growth and early life history of capelin (Mallotus villosus). NAFO Sci. Coun. Studies 24: 55-68.

Rivard, D. 1982. APL programs for stock assessment (revised). Can. Tech. Rep. Fish. Aquat. Sci. 1091: 146 p.

Shelton, P.A., Fahrig, L., and Millar, R.B. 1991. Incertainty associated with cod-capelin interactions: how much is too much? NAFO Sci. Coun. Studies 16: 13-19.

Shelton, P.A., and Lilly, G.R. MS 1995. Factors influencing weight at age of cod off eastern Newfoundland (NAFO Divisions 2J+3KL). ICES C.M.1995/P:14. 29 p.

Shelton, P.A., Lilly, G.R., and Colbourne, E. MS 1996. Patterns in the annual weight increment for 2J3KL cod and possible prediction for stock projection. NAFO SCR Doc. 96/47, Serial No. N2722. 23 p.

Smith, S.J., and Somerton, G.D. 1981. STRAP: A user-oriented computer analysis system for groundfish research trawl survey data. Can. Tech. Rep. Fish. Aquat. Sci. 1030: iv + 66 p.

Taggart, C.T., Anderson, J., Bishop, C., Colbourne, E., Hutchings, J., Lilly, G., Morgan, J., Murphy, E., Myers, R., Rose, G., and Shelton, P. 1994. Overview of cod stocks, biology, and environment in the Northwest Atlantic region of Newfoundland, with emphasis on northern cod. ICES mar. Sci. Symp. 198: 140-157.

Warren, W.G. 1997. Report on the comparative fishing trial between the Gadus Atlantica and Teleost. NAFO Sci. Coun. Studies 29: 81-92.

Wells, R. MS 1984. Growth of cod in Divisions 2J, 3K and 3L, 1971-83. NAFO SCR Doc. 84/90, Serial No. N881. 6 p.

Wells, R. MS 1986. Declines in the average length at age of cod in Divisions 2J and 3K during 1977-85. NAFO SCR Doc. 86/83, Serial No. N1205. 2 p.

Table 1. Number of cod sampled for length and age, by Division and age, during autumn bottom-trawl surveys in Divisions 2J, 3K and 3L in 1978-1997.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1			19		73	43	13	6	2	8	43	18	15	1			1	117	44	
2	19	16	65	101	94	121	70	54	63	40	121	193	93	61	13	27	7	116	190	33
3	71	40	61	81	122	97	160	102	63	103	92	125	202	56	87	15	27	108	108	112
4	65	88	52	57	68	88	142	190	65	69	71	92	111	187	39	29	13	43	43	33
5	100	73	91	35	40	63	265	133	86	149	55	59	74	96	104	12	8	12	11	10
6	61	105	88	77	23	34	123	195	63	143	102	55	67	37	18	15	2	2	2	
7	41	47	108	87	71	21	47	123	67	91	133	113	52	35	2	1	4		2	
8	20	30	35	102	81	70	37	39	57	94	57	124	125	24						
9	25	15	25	47	113	64	82	34	23	63	73	40	72	26						
10	18	14	17	25	61	74	57	63	18	22	59	37	20	15						
11	11	17	13	5	34	17	36	27	27	5	20	26	15	4						
12	5	7	15	9	23	14	17	14	19	16	12	7	6	3						

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1		1	16	3	21	60	26	2	33	36	60	68	72	1	4	1	3	116	94	13
2	14	10	88	85	110	113	98	56	79	70	166	211	106	122	60	95	10	139	183	93
3	68	52	80	131	84	106	110	89	56	73	175	135	168	86	118	101	38	136	123	105
4	93	79	47	49	89	66	107	83	90	56	101	128	124	151	73	80	21	55	44	33
5	86	93	102	30	59	96	71	87	73	78	86	86	84	128	164	29	11	16	16	12
6	69	94	125	93	29	36	87	52	64	62	130	73	73	93	81	38	2	3	2	
7	42	61	68	121	68	32	38	77	49	53	98	109	64	71	31	10	4		1	
8	29	60	71	68	115	68	30	44	69	57	69	89	121	45	8	1	3			1
9	20	22	42	35	72	100	79	37	42	66	47	52	79	36	1			1		
10	23	14	27	21	45	48	77	43	31	46	32	50	39	24						
11	2	15	2	18	20	29	51	51	37	33	9	21	30	3						
12	6	2	18	17	9	13	30	21	21	21	11	10	9	2						

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1				33	34	46		1	6	16	10	4	6	13	1			15	9	9
2				22	203	111		75	62	102	101	75	45	80	64	53	7	52	35	79
3				122	118	154		115	63	76	110	115	117	71	107	95	27	80	42	75
4				53	148	74		105	108	78	51	80	116	88	71	107	58	43	37	27
5				61	59	120		104	71	94	67	51	70	91	74	60	23	24	21	17
6				84	54	29		74	99	81	74	71	58	90	98	45	7	17	12	3
7				147	81	39		94	50	74	80	92	64	29	48	15	3	4	7	11
8				44	104	94		40	82	52	69	60	75	31	10	2	1	1	1	13
9				16	29	65		53	45	77	53	74	66	40	8				1	1
10				7	11	25		53	24	14	43	41	31	17	7	1				
11				4	7	10		44	40	21	22	18	19	12	3					
12				3	6	5		24	26	28	19	9	16	5	2					

Table 2. Number of cod sampled for length, age and round weight, by Division and age, during autumn bottom-trawl surveys in Divisions 2J, 3K and 3L in 1978-1997.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1			10			4	2	1		3	5	18	14	1			1	116	44	
2	7	8	16	20	18	25	17	17	13	10	24	192	93	61	13	27	7	116	189	33
3	18	12	12	19	19	21	74	32	8	7	22	125	202	56	87	15	27	108	108	112
4	15	16	12	11	14	16	80	117	9	10	10	92	111	187	39	29	13	43	43	33
5	15	13	10	4	9	12	176	80	17	13	14	59	74	96	104	12	8	12	11	10
6	14	16	18	12	7	5	75	121	12	13	17	55	67	37	18	15	2	2	2	
7	10	12	18	15	15	3	24	71	12	9	31	113	52	35	2	1	4		2	
8	6	6	4	19	12	12	14	13	9	6	13	124	125	24						
9	10	8	11	12	17	17	26	6	3	10	15	40	72	26						
10	8	4	5	8	9	22	21	24	5	5	24	37	20	15						
11	9	7	6	3	3	8	11	11	10	3	8	26	15	4						
12	4	3	11	4	2	11	11	8	7	4	8	7	6	3						

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1		1	8	1	6	8			4		9	68	72	1	4	1	3	116	89	13
2	7	5	22	14	25	18	11	11	11	9	31	211	106	122	60	95	10	139	165	93
3	12	16	11	23	10	15	20	17	8	14	32	135	168	86	117	101	38	136	117	105
4	26	15	6	10	20	16	20	9	14	10	25	128	123	151	73	80	21	55	43	33
5	22	8	14	1	7	14	9	15	14	11	14	86	84	128	163	29	11	16	16	12
6	16	14	30	18	6	7	16	13	16	10	28	73	73	93	81	38	2	3	2	
7	10	15	8	21	10	6	7	13	5	10	20	109	64	71	31	10	4		1	
8	4	14	14	15	19	8		9	11	9	19	89	121	45	8	1	3			1
9	7	9	9	6	20	12	16	8	14	17	18	52	79	36	1			1		
10	7	9	6	10	12	12	18	11	6	12	23	50	39	24						
11	2	8	1	7	7	15	14	16	8	2	7	21	30	3						
12	4	1	13	8	3	2	11	8	3	10	9	10	9	2						

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1				4	2	7							6	13	1			15	9	9
2				4	16	20		8	9	17	14	10	45	79	64	53	7	52	35	79
3				17	7	22		22	8	14	14	17	117	71	107	95	27	80	42	75
4				14	1	5		16	20	16	12	18	116	87	71	106	58	43	37	27
5				10		18		18	9	15	11	7	70	91	74	60	23	24	21	17
6				15		6		11	16	14	11	13	58	90	98	45	7	17	12	3
7				24		7		7	13	12	11	15	64	29	48	15	3	4	7	10
8				14	1	14		7	12	10	16	13	75	31	10	2	1	1	1	12
9				10	5	22		14	10	18	8	13	66	40	8				1	
10				6	5	9		13	7	2	11	10	31	17	7	1				
11				4	5	6		16	15	9	8	6	19	12	3					
12				3	4	3		6	8	14	14	3	16	5	2					

Table 3. Mean length (cm) at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-1997. Highlighted entries are based on fewer than 5 aged fish. There were no surveys in Division 3L in 1978-1980 and 1984.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1																		19.9	19.8	
2	29.3	30.1	30.6	29.9	30.0	26.6	27.4	27.0	28.2	29.4	30.3	28.1	26.5	28.1	26.5	26.2	25.8	26.2	28.0	30.7
3	38.0	41.3	39.4	38.7	37.9	38.8	34.3	33.6	35.5	36.5	37.3	36.9	33.8	32.9	33.8	32.6	36.8	33.1	34.5	37.6
4	45.6	47.3	49.6	47.0	47.0	46.1	44.4	40.1	41.1	43.4	44.2	43.7	41.9	38.7	38.8	40.1	42.3	42.1	41.8	43.2
5	54.0	55.3	54.5	54.4	53.4	53.9	50.9	48.5	47.6	48.9	48.5	50.1	46.9	43.9	41.8	43.9	46.6	46.7	49.3	48.0
6	59.7	60.9	60.7	58.2	59.3	60.0	56.6	53.2	52.7	52.4	53.6	53.8	53.4	51.1	47.0	47.5	**56.8**	**55.4**	**52.6**	
7	66.4	67.9	64.3	62.8	61.3	62.9	63.4	57.5	56.7	57.3	55.8	57.0	56.6	56.9	**56.8**	**47.0**	**56.2**		**61.1**	
8	69.7	73.9	69.5	66.9	64.5	64.7	65.8	64.3	59.5	58.9	59.8	59.6	59.4	58.3						
9	79.3	69.2	82.0	73.6	68.9	68.6	66.9	67.2	67.6	61.7	63.8	62.7	61.1	63.8						
10	80.4	76.9	83.3	84.2	77.0	73.5	71.6	70.2	68.2	67.8	66.2	64.7	63.1	65.5						
11	87.7	87.6	86.5	90.1	85.5	75.0	78.4	72.8	72.2	77.5	73.9	69.8	73.6	**72.7**						
12	91.6	85.9	87.9	88.6	94.6	95.0	83.0	75.9	76.2	75.5	80.5	67.8	73.5	**68.5**						

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1																		18.6	19.2	21.6
2	27.9	30.9	30.7	31.3	29.3	28.5	26.5	28.7	29.5	29.7	25.9	27.3	28.1	29.2	28.5	28.5	29.3	25.6	28.7	29.5
3	37.6	42.1	39.9	42.2	40.3	40.5	36.8	36.0	36.5	38.1	36.5	37.2	36.2	36.6	36.4	37.5	36.5	34.2	34.9	39.2
4	47.0	49.5	47.2	50.4	50.1	47.9	47.0	43.9	43.8	44.6	44.2	45.0	44.0	42.7	42.4	43.6	42.2	41.8	43.3	47.9
5	54.8	55.4	54.7	56.1	54.0	56.2	54.3	51.8	49.9	50.9	51.5	51.5	49.7	47.9	47.0	50.0	51.1	46.8	50.0	56.2
6	62.4	62.8	61.8	60.3	60.5	62.3	61.6	57.3	56.1	54.3	56.0	56.3	56.1	54.9	51.8	51.4	**53.5**	**54.7**	**58.5**	
7	69.5	69.9	69.7	65.2	64.3	66.8	64.4	62.5	58.8	60.1	58.6	59.9	58.4	59.7	57.9	53.0	**58.1**		**69.0**	
8	74.4	76.8	76.3	69.2	69.0	67.7	68.8	69.6	64.1	62.9	66.3	63.1	61.2	62.7	65.2	**64.0**	**61.7**			**68.0**
9	76.6	83.3	86.0	81.7	74.8	72.5	72.9	70.2	67.3	69.7	73.1	68.1	63.6	65.6	**64.0**			**68.0**		
10	81.9	78.3	87.6	90.5	79.8	76.4	78.1	73.1	76.6	74.5	78.7	74.0	64.7	69.1						
11	**88.4**	86.0	**103.4**	91.6	89.6	84.9	84.9	79.2	75.9	80.8	82.4	75.7	69.3	**80.7**						
12	92.1	**78.9**	94.2	92.1	97.0	85.1	90.2	87.1	73.7	86.6	88.5	82.2	71.1	**68.4**						

Division 3L

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1															16.8	17.7	19.7
2	28.5	28.7	30.1		26.8	27.9	27.5	28.7	28.7	27.0	29.7	27.9	30.1	28.1	27.8	30.0	30.3
3	40.0	38.2	39.4		36.1	35.4	34.7	37.4	37.6	35.3	36.7	38.5	38.3	34.8	36.9	38.3	38.6
4	44.8	50.2	48.0		43.7	43.7	44.2	44.9	44.2	44.9	44.4	44.5	45.2	45.7	41.7	44.2	45.9
5	52.6	56.4	56.8		52.2	50.3	52.3	53.1	52.3	52.7	51.1	50.4	51.5	51.8	49.6	49.3	54.9
6	60.6	63.5	62.4		58.0	58.2	58.9	58.6	59.0	59.2	56.5	54.9	55.8	57.9	58.6	58.9	**62.3**
7	66.7	69.7	64.7		65.4	62.6	65.1	62.4	63.9	66.4	61.1	56.8	61.9	**66.7**	**66.7**	66.7	68.6
8	73.1	73.8	69.5		73.3	69.9	69.0	66.7	68.7	70.9	68.0	66.0	**61.4**	**67.0**	**74.0**	**70.0**	72.6
9	82.2	83.0	73.6		72.8	73.1	75.2	69.6	74.4	75.3	71.5	77.3				**66.0**	**72.0**
10	91.2	93.1	76.3		82.6	77.7	80.8	74.3	83.7	76.2	73.2	70.4	**87.0**				
11	**103.7**	94.1	90.0		86.5	81.5	87.9	88.9	88.1	82.5	74.5	**77.1**					
12	**119.2**	110.5	87.5		97.8	86.8	85.4	96.7	94.1	86.9	81.1	**94.5**					

Table 4. Mean weight (kg) at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-1997. Highlighted entries are based on fewer than 5 aged fish. There were no surveys in Division 3L in 1978-1980 and 1984.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1																		0.064	0.064	
2	0.223	0.263	0.240	0.228	0.215	0.176	0.153	0.200	0.254	0.266	0.253	0.204	0.158	0.187	0.139	0.153	0.155	0.162	0.193	0.258
3	0.487	0.682	0.528	0.548	0.501	0.587	0.384	0.363	0.350	0.545	0.553	0.488	0.355	0.307	0.318	0.300	0.433	0.319	0.371	0.480
4	0.947	1.023	1.046	1.077	0.955	0.956	0.829	0.622	0.645	0.913	0.819	0.810	0.697	0.518	0.482	0.575	0.646	0.671	0.670	0.733
5	1.580	1.593	1.363	1.663	1.601	1.554	1.303	1.138	1.054	1.355	1.145	1.263	0.987	0.743	0.620	0.751	0.909	0.898	1.160	1.052
6	2.199	2.379	2.055	1.982	2.004	1.353	1.782	1.486	1.660	1.483	1.653	1.567	1.462	1.139	0.844	0.923	1.664	1.540	1.427	
7	2.515	2.748	2.548	2.519	2.392	2.252	2.388	1.880	1.914	2.067	1.690	1.907	1.784	1.540	1.478	0.860	1.700		2.150	
8	3.862	2.753	3.090	3.197	2.686	2.773	2.562	2.497	2.292	2.409	2.379	2.259	2.108	1.692						
9	4.365	6.193	5.986	3.944	3.872	3.346	3.023	2.652	3.810	1.818	2.717	2.616	2.299	2.367						
10	5.771	5.428	7.628	6.586	6.507	4.022	3.459	3.223	4.513	4.648	2.880	3.143	2.539	2.721						
11	6.358	7.191	6.546	6.906	7.660	4.165	5.669	4.178	4.638	4.550	3.868	3.771	4.397	3.963						
12	9.736	6.206	7.723	10.797	10.055	8.946	6.539	4.014	6.161	4.649	6.732	3.206	4.340	3.391						

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1																		0.054	0.057	0.085
2	0.171	0.207	0.238	0.275	0.234	0.227	0.146	0.209	0.192	0.204	0.177	0.193	0.190	0.213	0.205	0.205	0.217	0.153	0.206	0.230
3	0.410	0.577	0.578	0.720	0.738	0.540	0.404	0.466	0.454	0.493	0.476	0.491	0.414	0.423	0.398	0.473	0.434	0.362	0.380	0.543
4	0.876	1.190	0.950	1.222	1.218	1.120	0.867	0.891	0.817	0.904	0.838	0.874	0.761	0.705	0.665	0.735	0.688	0.649	0.721	0.979
5	1.478	1.644	1.410	1.730	1.555	1.670	1.412	1.219	1.154	1.350	1.411	1.325	1.100	1.006	0.947	1.119	1.188	0.907	1.161	1.619
6	2.393	2.259	2.011	2.051	1.966	2.114	2.041	1.818	1.993	1.409	1.734	1.821	1.630	1.517	1.301	1.296	1.442	1.527	1.898	
7	2.938	3.161	3.462	2.620	2.445	2.804	2.343	2.590	2.421	2.580	2.264	2.190	1.908	1.923	1.828	1.461	1.978		3.240	
8	5.830	4.281	3.179	5.051	3.151	3.440		3.396	3.739	2.784	3.012	2.566	2.203	2.274	2.561	2.290	2.326			2.610
9	4.671	4.861	6.003	7.332	4.375	3.736	3.693	4.149	3.247	3.398	4.257	3.229	2.441	2.626	2.190			3.280		
10	6.499	4.608	7.532	6.321	6.192	4.832	4.667	4.890	4.920	5.354	4.888	4.204	2.711	3.107						
11	5.243	8.365	13.000	9.326	6.515	7.512	6.300	6.520	5.847	10.631	5.408	4.604	3.251	4.933						
12	9.492	10.190	7.097	8.103	9.555	6.047	6.089	6.329	6.465	7.017	7.628	5.593	3.665	3.222						

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1																		0.110	0.047	0.068
2				0.224	0.169	0.236		0.167	0.223	0.179	0.224	0.186	0.173	0.248	0.198	0.240	0.198	0.235	0.256	0.255
3				0.564	0.380	0.539		0.436	0.468	0.353	0.459	0.443	0.395	0.456	0.581	0.505	0.402	0.459	0.501	0.533
4				0.820	0.480	1.142		0.801	0.796	0.735	0.764	0.789	0.810	0.836	0.883	0.849	0.880	0.668	0.785	0.896
5				1.245		1.477		1.382	1.227	1.313	1.372	1.556	1.330	1.280	1.303	1.274	1.319	1.134	1.122	1.629
6				1.980		1.984		2.049	1.807	1.796	1.879	1.937	1.902	1.748	1.700	1.764	1.893	2.055	2.084	2.633
7				2.638		2.278		2.247	2.703	2.351	2.103	2.567	2.767	2.191	1.862	2.327	2.986	3.253	3.229	3.386
8				5.077	5.440	2.930		3.521	2.579	2.818	3.043	3.653	3.481	3.089	2.781	2.550	3.160	4.200	3.440	4.473
9				5.804	6.647	4.005		4.111	4.197	3.801	3.015	3.666	4.274	3.678	4.926				3.200	
10				11.762	8.339	4.390		6.132	5.476	7.540	3.483	6.830	4.557	3.949	3.349	6.440				
11				11.560	7.486	8.333		5.312	4.460	7.402	7.471	7.461	5.847	4.471	4.946					
12				18.553	10.653	9.902		12.081	10.511	5.525	9.410	11.395	6.642	5.307	8.652					

Table 5. Mean Fulton's condition (round weight) at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-1997. Highlighted entries are based on fewer than 5 aged fish. There were no surveys in Division 3L in 1978-1980 and 1984.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.846	0.845	0.848	0.916	0.835	0.853	0.849	0.859	0.881	0.863	0.891	0.879	0.828	0.820	0.745	0.834	0.882	0.834	0.847	0.864
3	0.872	0.900	0.920	0.958	0.904	0.949	0.938	0.927	0.920	0.980	0.932	0.942	0.886	0.845	0.800	0.851	0.850	0.847	0.864	0.882
4	0.898	0.923	0.814	0.973	0.886	1.005	0.961	0.955	1.036	0.979	0.999	0.954	0.924	0.870	0.809	0.872	0.851	0.868	0.892	0.884
5	0.937	0.907	0.948	**0.957**	0.956	0.944	0.983	0.979	1.033	0.985	0.979	0.992	0.935	0.854	0.829	0.869	0.888	0.864	0.953	0.937
6	0.909	0.995	0.927	1.022	0.945	0.897	0.955	0.978	1.079	1.036	1.030	0.996	0.947	0.839	0.794	0.842	**0.908**	**0.895**	**0.769**	
7	0.879	0.922	0.930	1.004	0.930	**0.861**	0.945	0.962	1.041	0.969	1.010	1.020	0.967	0.821	**0.805**	**0.828**	**0.953**		**0.824**	
8	0.905	0.818	**0.935**	1.058	0.896	1.015	0.931	0.973	0.974	1.102	1.013	1.052	0.994	0.846						
9	0.959	1.041	1.037	0.921	0.900	1.001	0.961	0.831	**1.127**	0.960	1.158	1.040	0.992	0.895						
10	0.979	**0.995**	1.077	1.066	1.005	0.951	0.947	0.931	1.004	0.974	1.071	1.141	0.966	0.948						
11	1.038	1.061	0.991	**1.018**	**1.061**	0.969	0.986	0.987	1.136	**1.061**	1.065	1.067	1.048	**1.033**						
12	**1.149**	**1.031**	1.116	**1.059**	**1.105**	0.955	1.007	0.988	1.054	**1.039**	1.098	1.003	1.079	**0.983**						

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.801	0.790	0.795	0.917	0.813	0.829	0.775	0.861	0.845	0.863	0.859	0.851	0.817	0.835	0.840	0.847	0.837	0.851	0.846	0.863
3	0.807	0.859	0.917	0.922	0.949	0.860	0.835	0.896	0.900	0.904	0.921	0.912	0.841	0.846	0.810	0.868	0.869	0.862	0.866	0.879
4	0.848	0.910	0.946	0.886	0.882	0.934	0.850	0.873	0.970	0.932	0.958	0.932	0.875	0.885	0.853	0.871	0.882	0.846	0.861	0.872
5	0.856	0.928	0.892	**0.934**	0.886	0.898	0.892	0.936	0.983	0.952	0.984	0.949	0.884	0.892	0.883	0.872	0.865	0.868	0.906	0.908
6	0.863	0.926	0.869	0.959	0.860	0.862	0.889	0.951	1.071	0.962	1.012	1.013	0.911	0.906	0.912	0.935	**0.936**	**0.892**	**0.900**	
7	0.853	0.887	0.846	0.892	0.877	0.934	0.930	0.909	1.052	1.073	1.029	1.004	0.943	0.890	0.926	0.959	**0.979**		**0.986**	
8	**0.903**	0.898	0.822	0.915	0.894	0.962		0.933	1.015	0.997	1.089	1.004	0.948	0.900	0.917	**0.874**	**0.973**			**0.830**
9	0.947	0.918	0.907	1.046	0.858	0.958	0.941	1.067	1.044	1.034	1.020	1.006	0.922	0.915	**0.835**			**1.043**		
10	0.908	0.962	0.955	0.925	0.960	0.952	0.860	0.924	1.102	1.118	1.057	0.997	0.966	0.936						
11	**0.778**	0.952	**1.032**	1.098	0.901	1.048	1.031	0.969	1.086	**1.126**	0.998	1.023	0.951	**0.907**						
12	**1.066**	**1.117**	0.982	1.025	**1.017**	**0.906**	0.969	1.037	**1.028**	1.029	1.088	0.967	1.025	**0.978**						

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2				**0.841**	0.798	0.824		0.771	0.882	0.842	0.878	0.846	0.801	0.890	0.859	0.840	0.870	1.087	0.887	0.885
3				0.906	0.904	0.830		0.876	0.878	0.856	0.917	0.874	0.861	0.889	0.977	0.877	0.920	0.894	0.864	0.889
4				0.914	**0.875**	0.847		0.875	0.887	0.864	0.884	0.878	0.861	0.931	0.979	0.902	0.893	0.889	0.893	0.904
5				0.924		0.846		0.882	0.931	0.877	0.925	0.926	0.892	0.931	1.000	0.923	0.937	0.912	0.900	0.960
6				0.884		0.810		0.838	0.913	0.837	0.955	0.919	0.906	0.946	1.001	0.999	0.959	**0.990**	0.999	**0.998**
7				0.903		0.917		0.844	0.966	0.855	0.890	0.917	0.929	0.909	0.974	0.979	**0.996**	**1.071**	1.064	1.050
8				1.004	**0.886**	0.897		0.871	0.851	0.883	0.912	0.997	0.952	0.965	0.945	**1.057**	**1.051**	**1.036**	**1.003**	1.132
9				0.955	0.968	0.895		0.957	0.965	0.895	0.970	0.924	0.965	0.970	1.013				**1.113**	
10				1.119	0.973	0.899		0.978	1.003	**1.094**	0.922	1.046	0.964	0.958	0.946	**0.978**				
11				**1.004**	0.982	0.963		0.942	0.928	0.961	0.995	1.035	1.001	1.036	**1.058**					
12				**1.104**	**0.938**	**0.903**		1.019	1.029	0.943	1.051	**1.107**	0.969	0.980	**1.019**					

Table 6. Mean Fulton's condition (gutted weight) at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-1997. Highlighted entries are based on fewer than 5 aged fish.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.733	0.718	0.738	0.781	0.735	0.731	0.713	0.722	0.718	0.730	0.753	0.745	0.714	0.710	0.666	0.741	0.803	0.740	0.733	0.743
3	0.729	0.755	0.788	0.811	0.775	0.772	0.758	0.741	0.779	0.813	0.786	0.764	0.741	0.736	0.710	0.758	0.755	0.743	0.755	0.758
4	0.762	0.763	0.718	0.810	0.757	0.803	0.774	0.755	0.814	0.792	0.816	0.772	0.745	0.735	0.693	0.750	0.745	0.758	0.791	0.755
5	0.771	0.750	0.764	**0.816**	0.816	0.774	0.784	0.769	0.816	0.770	0.786	0.786	0.744	0.724	0.709	0.752	0.773	0.736	0.809	0.787
6	0.747	0.785	0.750	0.821	0.801	0.729	0.767	0.757	0.815	0.783	0.812	0.789	0.753	0.702	0.678	0.717	**0.771**	**0.735**	**0.769**	
7	0.731	0.762	0.738	0.795	0.757	**0.661**	0.776	0.751	0.814	0.783	0.798	0.782	0.743	0.707	**0.687**	**0.722**	**0.779**		**0.824**	
8	0.722	0.695	**0.743**	0.809	0.737	0.789	0.732	0.761	0.776	0.836	0.815	0.806	0.762	0.705						
9	0.764	0.823	0.806	0.749	0.729	0.789	0.751	0.669	**0.849**	0.768	0.811	0.793	0.771	0.738						
10	0.779	**0.794**	0.814	0.859	0.814	0.758	0.755	0.724	0.794	0.772	0.813	0.874	0.748	0.783						
11	0.834	0.831	0.760	**0.855**	**0.855**	0.801	0.786	0.730	0.870	**0.792**	0.798	0.806	0.817	**0.835**						
12	**0.904**	**0.766**	0.838	**0.845**	**0.858**	0.786	0.799	0.725	0.828	**0.795**	0.827	0.766	0.828	**0.830**						

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.683	0.707	0.708	0.793	0.722	0.725	0.685	0.730	0.749	0.768	0.753	0.716	0.711	0.733	0.735	0.727	0.741	0.733	0.739	0.744
3	0.719	0.741	0.786	0.793	0.815	0.742	0.719	0.744	0.714	0.757	0.785	0.750	0.714	0.719	0.700	0.741	0.767	0.744	0.746	0.758
4	0.747	0.757	0.805	0.769	0.758	0.781	0.733	0.731	0.774	0.772	0.796	0.755	0.724	0.736	0.711	0.720	0.768	0.730	0.753	0.747
5	0.747	0.780	0.747	**0.826**	0.754	0.768	0.753	0.765	0.783	0.785	0.799	0.763	0.734	0.733	0.718	0.717	0.730	0.737	0.782	0.766
6	0.739	0.747	0.726	0.789	0.738	0.728	0.744	0.784	0.798	0.778	0.808	0.781	0.744	0.742	0.739	0.746	**0.765**	**0.766**	**0.745**	
7	0.730	0.739	0.729	0.749	0.731	0.799	0.784	0.746	0.820	0.819	0.808	0.768	0.749	0.730	0.754	0.721	**0.780**		**0.801**	
8	**0.773**	0.746	0.687	0.751	0.732	0.809		0.764	0.795	0.788	0.833	0.779	0.749	0.738	0.736	**0.732**	**0.799**			**0.706**
9	0.784	0.738	0.758	0.847	0.721	0.760	0.781	0.841	0.821	0.796	0.819	0.791	0.732	0.755	**0.679**			**0.795**		
10	0.744	0.761	0.795	0.756	0.766	0.762	0.717	0.744	0.849	0.811	0.831	0.793	0.749	0.776						
11	**0.642**	0.752	**0.861**	0.836	0.749	0.838	0.822	0.778	0.840	**0.832**	0.788	0.808	0.771	**0.741**						
12	**0.845**	**0.812**	0.762	0.815	**0.813**	**0.755**	0.789	0.835	**0.785**	0.810	0.852	0.792	0.778	**0.803**						

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2				**0.718**	0.707	0.718		0.680	0.769	0.721	0.748	0.734	0.716	0.746	0.744	0.721	0.750	0.935	0.772	0.757
3				0.778	0.803	0.724		0.749	0.765	0.733	0.781	0.759	0.734	0.748	0.801	0.741	0.784	0.752	0.749	0.758
4				0.794	**0.765**	0.746		0.740	0.757	0.745	0.730	0.764	0.729	0.769	0.788	0.737	0.741	0.758	0.770	0.756
5				0.767		0.735		0.756	0.790	0.748	0.781	0.782	0.752	0.769	0.795	0.715	0.758	0.761	0.760	0.773
6				0.729		0.700		0.717	0.781	0.714	0.796	0.776	0.742	0.773	0.796	0.777	0.776	0.804	0.806	**0.770**
7				0.751		0.775		0.715	0.816	0.724	0.741	0.768	0.763	0.741	0.793	0.737	**0.775**	**0.861**	0.847	0.824
8				0.824	**0.767**	0.764		0.708	0.730	0.735	0.758	0.804	0.777	0.763	0.723	**0.741**	**0.725**	**0.780**	**0.825**	0.882
9				0.798	0.800	0.744		0.790	0.775	**0.743**	0.781	0.729	0.773	0.779	0.803				**0.939**	
10				0.888	0.827	0.749		0.783	0.808	**0.852**	0.746	0.798	0.785	0.758	0.743	**0.787**				
11				**0.800**	0.807	0.793		0.774	0.775	0.803	0.736	0.802	0.795	0.817	**0.814**					
12				**0.885**	**0.771**	**0.752**		0.817	0.811	0.783	0.828	**0.822**	0.792	0.771	**0.808**					

Table 7. Mean liver index at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-1997. Highlighted entries are based on fewer than 5 aged fish. (Instances where fewer than 5 fish were available are not indicated for years prior to 1995.) There were no surveys in Division 3L in 1978-1980 and 1984.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2		0.037	0.035	0.046	0.031	0.030	0.032	0.023	0.043	0.031	0.036	0.045	0.042	0.036	0.025	0.032	0.038	0.042	0.037	0.041
3		0.061	0.051	0.049	0.047	0.057	0.050	0.036	0.049	0.052	0.049	0.059	0.050	0.042	0.028	0.038	0.039	0.041	0.044	0.043
4		0.062	0.034	0.069	0.048	0.078	0.061	0.048	0.079	0.061	0.067	0.067	0.060	0.045	0.040	0.037	0.035	0.041	0.039	0.045
5		0.064	0.052	0.053	0.051	0.063	0.066	0.057	0.077	0.073	0.057	0.076	0.061	0.037	0.036	0.038	0.043	0.045	0.043	0.053
6		0.080	0.054	0.062	0.060	0.065	0.062	0.056	0.089	0.065	0.074	0.074	0.064	0.033	0.037	0.038	0.049	**0.017**	**0.037**	
7		0.060	0.055	0.056	0.057	0.057	0.055	0.053	0.074	0.061	0.070	0.077	0.067	0.031	0.036	0.030	0.073		**0.047**	
8		0.040	0.041	0.067	0.051	0.077	0.055	0.061	0.051	0.077	0.076	0.089	0.066	0.033						
9		0.060	0.071	0.058	0.048	0.081	0.066	0.034	0.093	0.045	0.065	0.074	0.073	0.038						
10		0.083	0.084	0.083	0.058	0.053	0.063	0.052	0.071	0.060	0.072	0.097	0.058	0.034						
11		0.097	0.074	0.058	0.052	0.062	0.065	0.065	0.092	0.075	0.068	0.083	0.065	0.042						
12		0.076	0.083	0.061	0.099	0.050	0.053	0.052	0.098	0.089	0.082	0.073	0.084	0.043						

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.030	0.019	0.021	0.040	0.020	0.024	0.013	0.035	0.029	0.029	0.025	0.032	0.035	0.037	0.035	0.042	0.034	0.045	0.039	0.040
3	0.020	0.033	0.038	0.044	0.033	0.039	0.032	0.053	0.049	0.046	0.044	0.047	0.042	0.044	0.037	0.043	0.044	0.046	0.044	0.045
4	0.032	0.054	0.047	0.041	0.045	0.052	0.037	0.053	0.061	0.049	0.056	0.056	0.052	0.052	0.048	0.045	0.049	0.047	0.044	0.045
5	0.040	0.066	0.046	0.035	0.061	0.047	0.046	0.054	0.069	0.056	0.069	0.057	0.051	0.054	0.055	0.051	0.053	0.050	0.046	0.049
6	0.037	0.062	0.052	0.054	0.044	0.035	0.041	0.054	0.082	0.064	0.070	0.071	0.055	0.052	0.059	0.058	0.054	**0.048**	**0.038**	
7	0.040	0.061	0.045	0.043	0.049	0.035	0.047	0.044	0.082	0.078	0.061	0.071	0.057	0.043	0.064	0.050	0.065		**0.059**	
8	0.057	0.058	0.049	0.049	0.052	0.066		0.055	0.074	0.051	0.078	0.072	0.066	0.046	0.059	0.032	0.071			**0.032**
9	0.059	0.055	0.045	0.070	0.042	0.046	0.047	0.075	0.064	0.053	0.059	0.072	0.060	0.052	0.061			**0.036**		
10	0.062	0.061	0.047	0.059	0.057	0.049	0.037	0.049	0.081	0.070	0.069	0.071	0.064	0.054						
11	0.033	0.066	0.051	0.077	0.055	0.063	0.065	0.066	0.080	0.091	0.073	0.075	0.062	0.038						
12	0.071	0.080	0.066	0.066	0.062	0.024	0.046	0.052	0.097	0.073	0.070	0.071	0.079	0.034						

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2				0.021	0.013	0.025		0.029	0.030	0.026	0.025	0.026	0.039	0.046	0.041	0.043	0.039	0.039	0.039	0.042
3				0.041	0.025	0.022		0.031	0.032	0.032	0.028	0.036	0.038	0.056	0.067	0.053	0.078	0.048	0.040	0.047
4				0.038	0.042	0.024		0.039	0.035	0.031	0.035	0.039	0.037	0.062	0.073	0.062	0.053	0.049	0.044	0.049
5				0.039		0.027		0.039	0.047	0.035	0.043	0.052	0.042	0.059	0.076	0.066	0.052	0.050	0.044	0.055
6				0.039		0.030		0.033	0.040	0.030	0.045	0.045	0.048	0.060	0.071	0.075	0.074	0.066	0.064	**0.053**
7				0.041		0.041		0.030	0.045	0.029	0.051	0.053	0.057	0.059	0.073	0.066	0.044	**0.080**	0.078	0.069
8				0.065	0.039	0.032		0.046	0.033	0.032	0.043	0.058	0.055	0.069	0.065	0.033	0.035	**0.053**	**0.102**	0.068
9				0.049	0.061	0.039		0.051	0.056	0.036	0.050	0.051	0.059	0.075	0.070				**0.137**	**0.087**
10				0.077	0.054	0.041		0.066	0.052	0.091	0.039	0.059	0.057	0.066	0.074	0.098				
11				0.052	0.068	0.042		0.060	0.048	0.059	0.044	0.067	0.069	0.074	0.090					
12				0.068	0.066	0.045		0.071	0.060	0.050	0.070	0.055	0.065	0.056	0.068					

Table 8. Mean weights-at-age (kg) of cod caught in the commercial and recreational fisheries and sentinel surveys in divisions 2J, 3K and 3L combined in the period 1962-1997. (See Lilly et al. MS 1998).

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
2	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14		0.11
3	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.44	0.32	0.35
4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.53	0.47	0.68
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.64	0.71	0.91
6	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.08	0.96	1.11
7	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.52	1.30	1.27
8	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.13	1.80	1.56
9	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.86	2.20	2.05
10	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.29	2.82	2.75
11	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.95	3.19	3.13
12	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.12	3.79	3.41
13	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	5.00	4.53	4.92
14	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	9.32	6.93	4.40
15	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	9.40	7.22	6.33
16	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	6.89	7.05	5.50
17	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	14.67	9.45	7.57
18	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	12.04	11.16	11.07
19	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	7.62	7.62	7.62
20	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	17.46	17.46	17.46

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	0.26	0.25	0.09			0.41	0.00		0.31	0.34		0.21	0.32
3	0.45	0.45	0.45	0.40	0.46	0.53	0.55	0.53	0.62	0.59	0.48	0.51	0.43
4	0.63	0.61	0.60	0.72	0.74	0.77	0.78	0.84	0.87	0.88	0.73	0.72	0.66
5	0.96	0.93	0.97	1.04	1.13	1.16	1.17	1.20	1.32	1.20	1.10	1.04	1.03
6	1.18	1.32	1.66	1.58	1.67	1.71	1.64	1.77	1.75	1.79	1.43	1.54	1.32
7	1.39	1.75	2.33	2.46	2.46	2.38	2.23	2.10	2.28	2.28	2.06	1.85	1.87
8	1.74	2.07	2.82	3.26	3.57	3.56	2.86	2.66	2.61	2.71	2.66	2.35	1.93
9	2.21	2.24	3.46	4.05	4.41	5.01	3.81	3.09	3.18	2.96	3.23	2.94	2.80
10	2.61	2.99	3.88	4.46	5.25	5.49	5.32	4.18	3.50	3.65	3.32	3.47	3.51
11	3.34	3.67	4.78	5.02	5.80	6.72	6.29	6.16	4.79	4.28	4.06	3.80	4.80
12	3.66	4.56	6.13	6.72	7.03	7.87	7.06	7.19	7.76	6.19	4.55	4.54	4.64
13	4.78	6.18	7.31	8.10	8.96	8.38	7.32	8.00	9.07	8.39	7.03	5.34	5.74
14	5.20	8.19	8.40	7.42	8.54	10.03	10.01	8.36	9.14	10.26	9.67	7.12	6.13
15	5.20	9.77	8.81	8.20	9.46	11.31	8.99	7.86	10.62	11.44	11.37	11.77	8.53
16	5.46	11.23	11.75	11.26	10.70	13.87	11.54	7.91	10.57	11.61	11.27	11.24	13.51
17	8.51	12.44	10.63	11.61	13.12	10.68	10.48	9.58	13.13	17.47	12.68	14.15	9.10
18	9.24	11.16	12.27	8.92	13.49	16.09	11.15	12.95	15.97	12.94	12.42	16.14	21.77
19	7.62	7.62	7.62	10.57	15.51	12.04	9.82		9.73	15.21	14.38	12.30	17.66
20	17.46	17.46	17.46	16.00	14.77	11.37	12.59		15.88	12.81	19.49	15.72	

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.29	0.26	0.29	0.17				0.21	0.40	0.32
3	0.49	0.48	0.42	0.36	0.29	0.57	0.40	0.49	0.72	0.51
4	0.73	0.74	0.69	0.61	0.58	0.71	0.68	0.79	0.99	0.84
5	1.08	1.03	1.06	0.97	0.81	0.97	0.98	1.51	1.30	1.49
6	1.38	1.44	1.50	1.41	1.19	1.25	1.41	1.95	1.90	2.01
7	1.67	1.83	1.94	1.88	1.73	1.59	1.85	2.24	2.38	2.44
8	2.21	2.07	2.22	2.27	2.05	8.40	2.05	2.47	2.77	2.87
9	2.51	2.64	2.44	2.63	2.66	9.23	3.05	2.53	3.30	3.78
10	3.04	3.02	3.06	3.14	2.24			2.93	3.19	4.30
11	4.37	3.96	3.58	3.80	2.68			4.51	5.44	4.23
12	5.49	5.41	4.68	4.96	4.95			2.01	4.35	6.33
13	6.55	7.50	6.23	5.49	5.34				7.63	6.22
14	8.60	9.24	8.51	7.61	7.02				4.46	
15	9.76	10.05	9.78	11.58						
16	9.73	9.34	12.58	11.01						
17	12.58	15.74	15.45	12.82						
18	16.01	18.66	13.58	13.00						
19	16.60		17.26	13.10						
20	11.03	17.64								

Table 9. Mean weights-at-age (kg) of cod caught in the commercial and recreational fisheries and sentinel surveys in divisions 2J, 3K and 3L combined in the period 1962-1997. Highlighted entries indicate cells that were blank in Table 8 and have been filled as described in the text.

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
2	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	**0.26**	0.11
3	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.44	0.32	0.35
4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.53	0.47	0.68
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.64	0.71	0.91
6	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.08	0.96	1.11
7	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.52	1.30	1.27
8	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.13	1.80	1.56
9	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.86	2.20	2.05
10	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.29	2.82	2.75
11	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.95	3.19	3.13
12	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.12	3.79	3.41
13	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	5.00	4.53	4.92
14	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	9.32	6.93	4.40
15	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	9.40	7.22	6.33
16	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	6.89	7.05	5.50
17	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	14.67	9.45	7.57
18	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	12.04	11.16	11.07
19	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	7.62	7.62	7.62
20	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	17.46	17.46	17.46

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	0.26	0.25	0.09	**0.26**	**0.26**	0.41	**0.26**	**0.26**	0.31	0.34	**0.26**	0.21	0.32
3	0.45	0.45	0.45	0.40	0.46	0.53	0.55	0.53	0.62	0.59	0.48	0.51	0.43
4	0.63	0.61	0.60	0.72	0.74	0.77	0.78	0.84	0.87	0.88	0.73	0.72	0.66
5	0.96	0.93	0.97	1.04	1.13	1.16	1.17	1.20	1.32	1.20	1.10	1.04	1.03
6	1.18	1.32	1.66	1.58	1.67	1.71	1.64	1.77	1.75	1.79	1.43	1.54	1.32
7	1.39	1.75	2.33	2.46	2.46	2.38	2.23	2.10	2.28	2.28	2.06	1.85	1.87
8	1.74	2.07	2.82	3.26	3.57	3.56	2.86	2.66	2.61	2.71	2.66	2.35	1.93
9	2.21	2.24	3.46	4.05	4.41	5.01	3.81	3.09	3.18	2.96	3.23	2.94	2.80
10	2.61	2.99	3.88	4.46	5.25	5.49	5.32	4.18	3.50	3.65	3.32	3.47	3.51
11	3.34	3.67	4.78	5.02	5.80	6.72	6.29	6.16	4.79	4.28	4.06	3.80	4.80
12	3.66	4.56	6.13	6.72	7.03	7.87	7.06	7.19	7.76	6.19	4.55	4.54	4.64
13	4.78	6.18	7.31	8.10	8.96	8.38	7.32	8.00	9.07	8.39	7.03	5.34	5.74
14	5.20	8.19	8.40	7.42	8.54	10.03	10.01	8.36	9.14	10.26	9.67	7.12	6.13
15	5.20	9.77	8.81	8.20	9.46	11.31	8.99	7.86	10.62	11.44	11.37	11.77	8.53
16	5.46	11.23	11.75	11.26	10.70	13.87	11.54	7.91	10.57	11.61	11.27	11.24	13.51
17	8.51	12.44	10.63	11.61	13.12	10.68	10.48	9.58	13.13	17.47	12.68	14.15	9.10
18	9.24	11.16	12.27	8.92	13.49	16.09	11.15	12.95	15.97	12.94	12.42	16.14	21.77
19	7.62	7.62	7.62	10.57	15.51	12.04	9.82	**11.70**	9.73	15.21	14.38	12.30	17.66
20	17.46	17.46	17.46	16.00	14.77	11.37	12.59	**13.16**	15.88	12.81	19.49	15.72	**15.97**

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.29	0.26	0.29	0.17	0.26	0.26	0.26	0.21	0.40	0.32
3	0.49	0.48	0.42	0.36	0.29	0.57	0.40	0.49	0.72	0.51
4	0.73	0.74	0.69	0.61	0.58	0.71	0.68	0.79	0.99	0.84
5	1.08	1.03	1.06	0.97	0.81	0.97	0.98	1.51	1.30	1.49
6	1.38	1.44	1.50	1.41	1.19	1.25	1.41	1.95	1.90	2.01
7	1.67	1.83	1.94	1.88	1.73	1.59	1.85	2.24	2.38	2.44
8	2.21	2.07	2.22	2.27	2.05	8.40	2.05	2.47	2.77	2.87
9	2.51	2.64	2.44	2.63	2.66	9.23	3.05	2.53	3.30	3.78
10	3.04	3.02	3.06	3.14	2.24	**2.87**	**2.87**	2.93	3.19	4.30
11	4.37	3.96	3.58	3.80	2.68	**4.11**	**4.11**	4.51	5.44	4.23
12	5.49	5.41	4.68	4.96	4.95	**5.15**	**5.15**	2.01	4.35	6.33
13	6.55	7.50	6.23	5.49	5.34	**6.17**	**6.17**	**6.17**	7.63	6.22
14	8.60	9.24	8.51	7.61	7.02	**7.71**	**7.71**	**7.71**	4.46	**7.71**
15	9.76	10.05	9.78	11.58	**10.47**	**10.47**	**10.47**	**10.47**	**10.47**	**10.47**
16	9.73	9.34	12.58	11.01	**10.98**	**10.98**	**10.98**	**10.98**	**10.98**	**10.98**
17	12.58	15.74	15.45	12.82	**14.67**	**14.67**	**14.67**	**14.67**	**14.67**	**14.67**
18	16.01	18.66	13.58	13.00	**15.08**	**15.08**	**15.08**	**15.08**	**15.08**	**15.08**
19	16.60	**16.16**	17.26	13.10	**15.65**	**15.65**	**15.65**	**15.65**	**15.65**	**15.65**
20	11.03	17.64	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**

Table 10. Beginning-of-year (January 1) weights-at-age calculated from actual and assumed commercial weights-at-age (Table 9) as described in the text. Highlighted entries indicate values copied from adjacent cells.

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
2	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.23	0.05
3	**0.22**	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.25	0.21	0.30
4	**0.43**	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.42	0.45	0.47
5	**0.70**	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.59	0.61	0.65
6	**1.04**	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	0.97	0.78	0.89
7	**1.43**	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.37	1.18	1.10
8	**1.88**	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.65	1.42
9	**2.37**	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.46	2.16	1.92
10	**2.90**	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.95	2.84	2.46
11	**3.46**	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.54	3.24	2.97
12	**3.95**	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.94	3.87	3.30
13	**5.01**	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	4.56	4.32	4.32
14	**5.79**	5.79	5.79	5.79	5.79	5.79	5.79	5.79	5.79	5.79	7.52	5.89	4.46
15	**5.82**	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	7.22	8.20	6.62
16	**5.97**	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	6.49	8.14	6.30
17	**6.13**	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	9.25	8.07	7.31
18	**6.25**	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	8.81	12.80	10.23
19	**6.33**	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.80	9.58	9.22
20	**6.89**	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	10.74	11.53	11.53

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	0.20	0.19	0.04	0.20	0.19	0.35	0.19	0.17194	0.22	0.29	0.18958	0.15	0.26
3	0.22	0.34	0.34	0.19	0.35	0.37	0.47	0.37	0.40	0.43	0.40	0.37	0.30
4	0.47	0.52	0.52	0.57	0.54	0.60	0.64	0.68	0.68	0.74	0.66	0.59	0.58
5	0.81	0.77	0.77	0.79	0.90	0.93	0.95	0.97	1.05	1.02	0.98	0.87	0.86
6	1.04	1.13	1.24	1.24	1.32	1.39	1.38	1.44	1.45	1.54	1.31	1.30	1.17
7	1.24	1.44	1.75	2.02	1.97	1.99	1.95	1.86	2.01	2.00	1.92	1.63	1.70
8	1.49	1.70	2.22	2.76	2.96	2.96	2.61	2.44	2.34	2.49	2.46	2.20	1.89
9	1.86	1.97	2.68	3.38	3.79	4.23	3.68	2.97	2.91	2.78	2.96	2.80	2.57
10	2.31	2.57	2.95	3.93	4.61	4.92	5.16	3.99	3.29	3.41	3.13	3.35	3.21
11	3.03	3.09	3.78	4.41	5.09	5.94	5.88	5.72	4.47	3.87	3.85	3.55	4.08
12	3.38	3.90	4.74	5.67	5.94	6.76	6.89	6.72	6.91	5.45	4.41	4.29	4.20
13	4.04	4.76	5.77	7.05	7.76	7.68	7.59	7.52	8.08	8.07	6.60	4.93	5.10
14	5.06	6.26	7.20	7.36	8.32	9.48	9.16	7.82	8.55	9.65	9.01	7.07	5.72
15	4.78	7.13	8.49	8.30	8.38	9.83	9.50	8.87	9.42	10.23	10.80	10.67	7.79
16	5.88	7.64	10.71	9.96	9.37	11.45	11.42	8.43	9.11	11.10	11.35	11.30	12.61
17	6.84	8.24	10.93	11.68	12.15	10.69	12.06	10.51	10.19	13.59	12.13	12.63	10.11
18	8.36	9.75	12.35	9.74	12.51	14.53	10.91	11.65	12.37	13.03	14.73	14.31	17.55
19	9.18	8.39	9.22	11.39	11.76	12.74	12.57	11.42	11.23	15.59	13.64	12.36	16.88
20	11.53	11.53	11.53	11.04	12.49	13.28	12.31	11.37	13.63	11.16	17.22	15.04	14.02

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.23	0.20	0.26	0.13	0.17	0.21	0.19	0.11	0.35	0.25	**0.25**	**0.25**
3	0.40	0.37	0.33	0.32	0.22	0.38	0.32	0.36	0.39	0.45	0.40	**0.40**
4	0.56	0.60	0.58	0.51	0.46	0.45	0.62	0.56	0.70	0.78	0.65	**0.65**
5	0.84	0.87	0.89	0.82	0.70	0.75	0.83	1.01	1.01	1.21	1.12	**1.12**
6	1.19	1.25	1.24	1.22	1.07	1.01	1.17	1.38	1.69	1.61	1.73	**1.73**
7	1.48	1.59	1.67	1.68	1.56	1.38	1.52	1.78	2.16	2.15	2.21	**2.21**
8	2.03	1.86	2.02	2.10	1.96	3.81	1.81	2.14	2.49	2.61	2.64	**2.64**
9	2.20	2.42	2.25	2.42	2.46	4.35	5.06	2.28	2.85	3.23	3.29	**3.29**
10	2.92	2.75	2.84	2.77	2.43	2.76	5.15	2.99	2.84	3.77	4.03	**4.03**
11	3.92	3.47	3.29	3.41	2.90	3.03	3.44	3.60	3.99	3.67	4.26	**4.26**
12	5.13	4.86	4.30	4.21	4.34	3.71	4.60	2.87	4.43	5.87	5.17	**5.17**
13	5.51	6.42	5.81	5.07	5.15	5.53	5.63	5.63	3.91	5.20	6.27	**6.27**
14	7.03	7.78	7.99	6.89	6.21	6.42	6.90	6.90	5.24	7.67	6.93	**6.93**
15	7.73	9.30	9.51	9.93	8.93	8.57	8.99	8.99	8.99	6.83	8.99	**8.99**
16	9.11	9.55	11.24	10.38	11.27	10.72	10.72	10.72	10.72	10.72	10.72	**10.72**
17	13.04	12.38	12.01	12.70	12.71	12.69	12.69	12.69	12.69	12.69	12.69	**12.69**
18	12.07	15.32	14.62	14.17	13.90	14.87	14.87	14.87	14.87	14.87	14.87	**14.87**
19	19.01	16.08	17.95	13.34	14.27	15.36	15.36	15.36	15.36	15.36	15.36	**15.36**
20	13.96	17.11	16.06	16.60	14.46	15.81	15.81	15.81	15.81	15.81	15.81	**15.81**

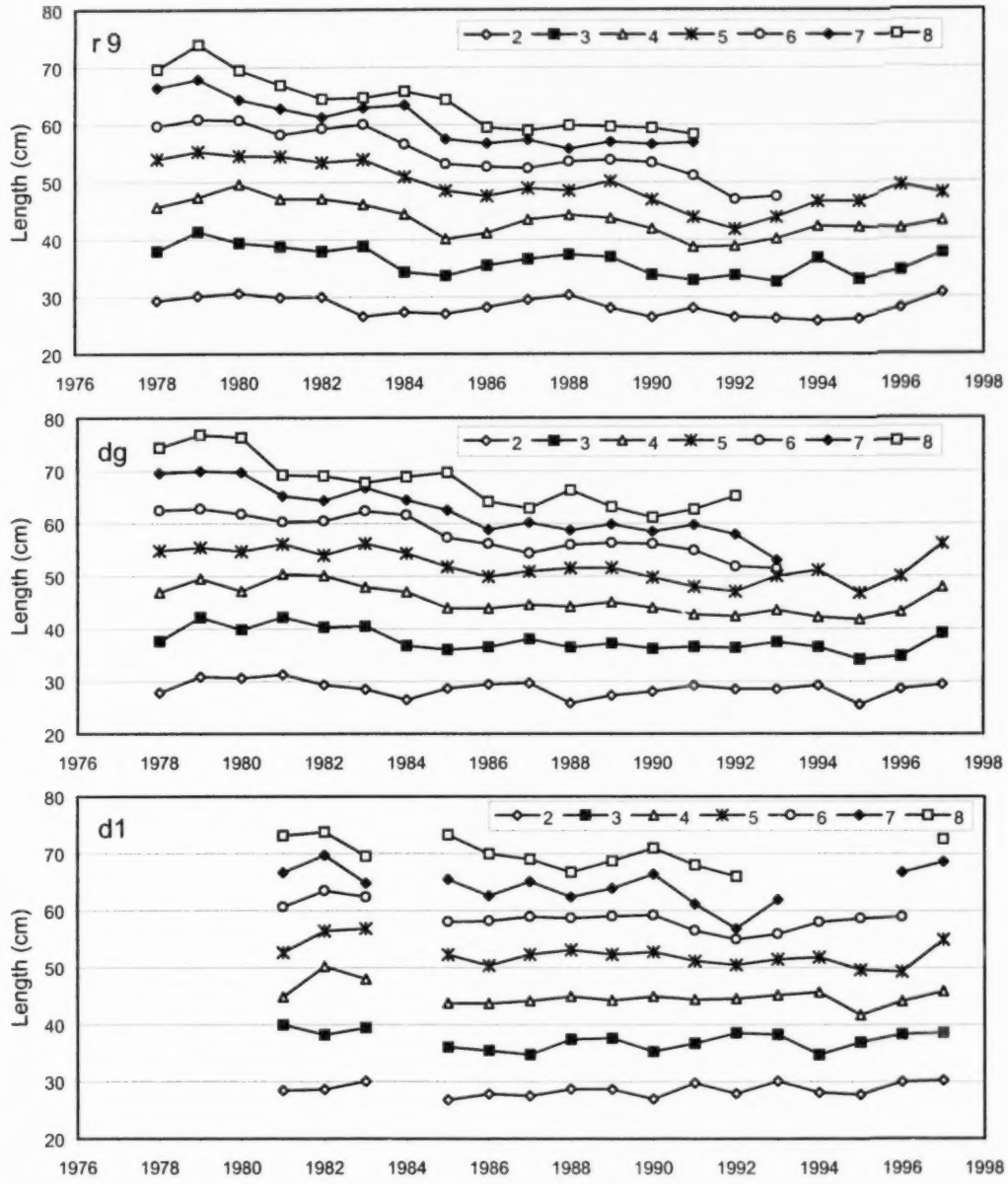

Fig. 1. Mean lengths at ages 2-8 of cod in Divisions 2J, 3K and 3L in 1978-1997, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

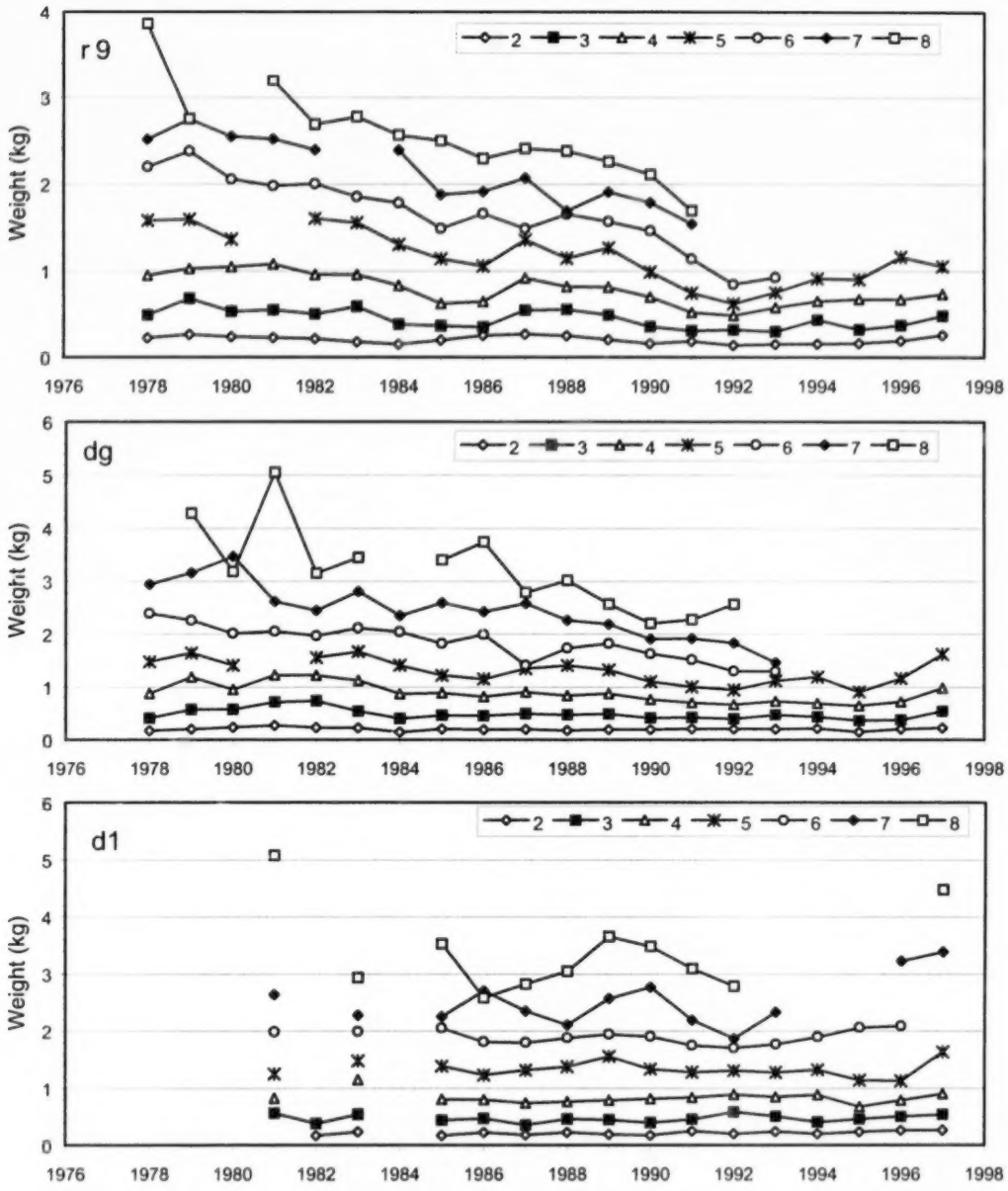

Fig. 2. Mean weights at ages 2-8 of cod in Divisions 2J, 3K and 3L in 1978-1997, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

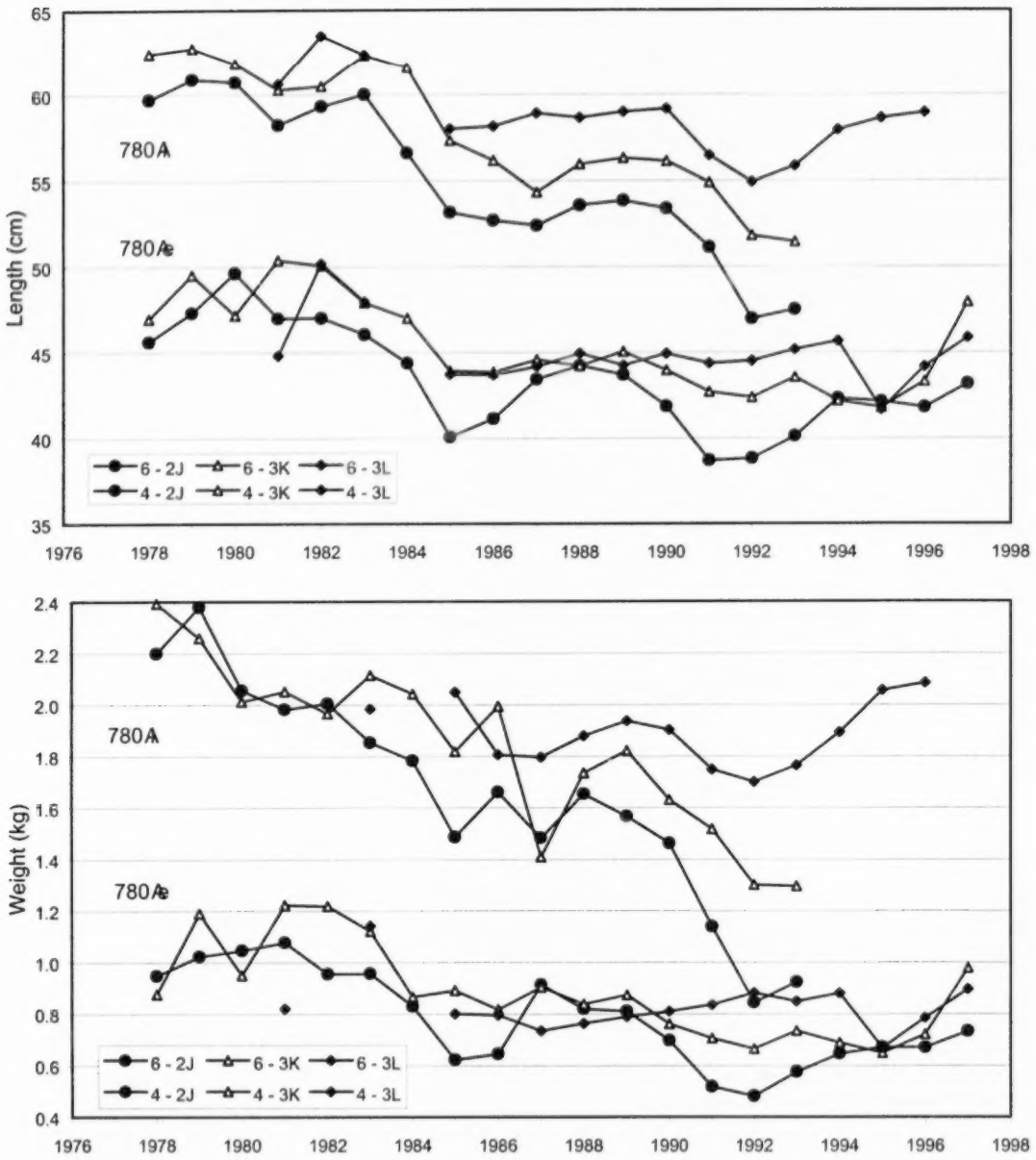

Fig. 3. Mean lengths and weights at ages 4 and 6 of cod in Divisions 2J, 3K and 3L in 1978-1997, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

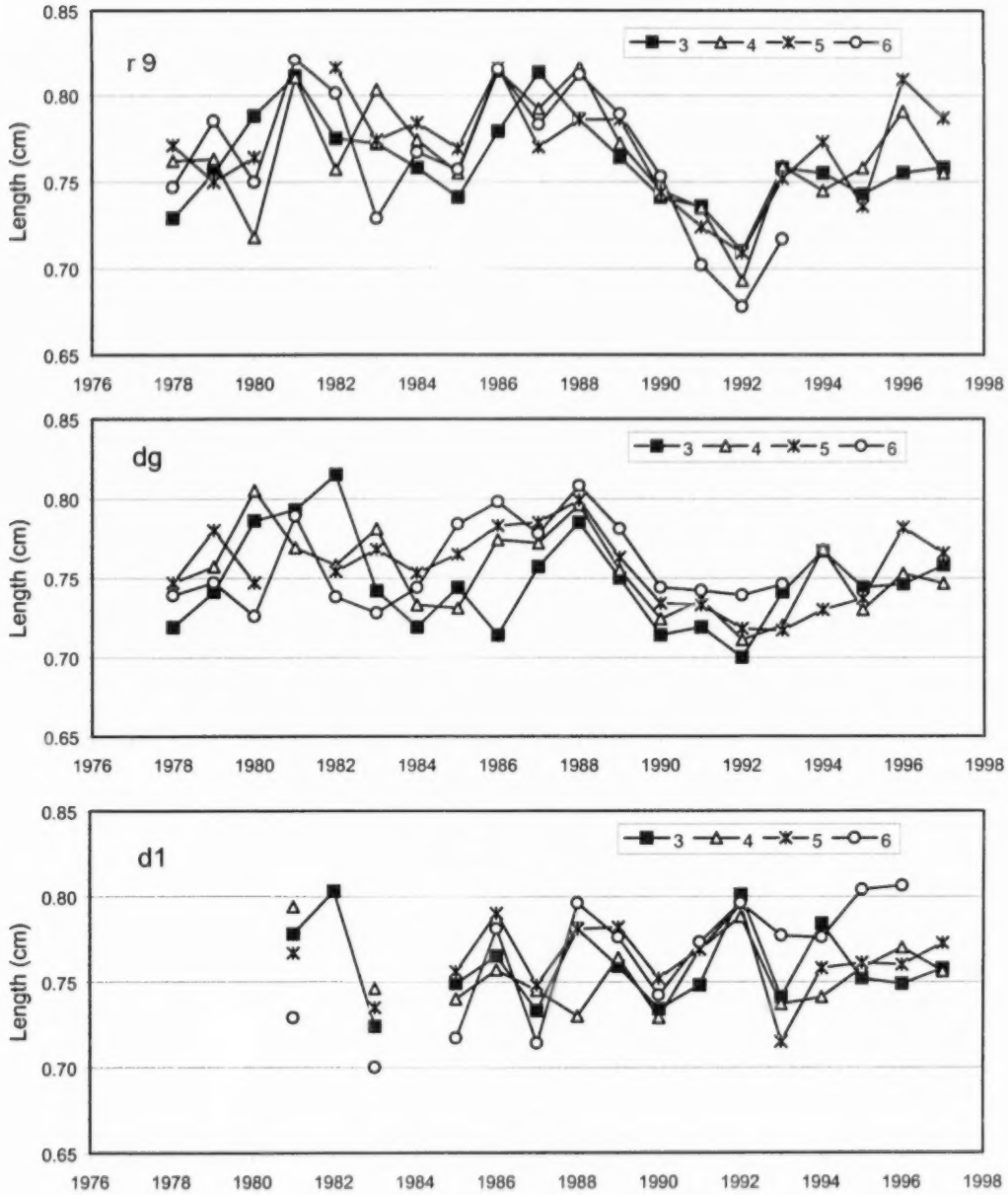

Fig. 4. Mean Fulton's condition (gutted weight) at ages 3-6 of cod in Divisions 2J, 3K and 3L in 1978-1997, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

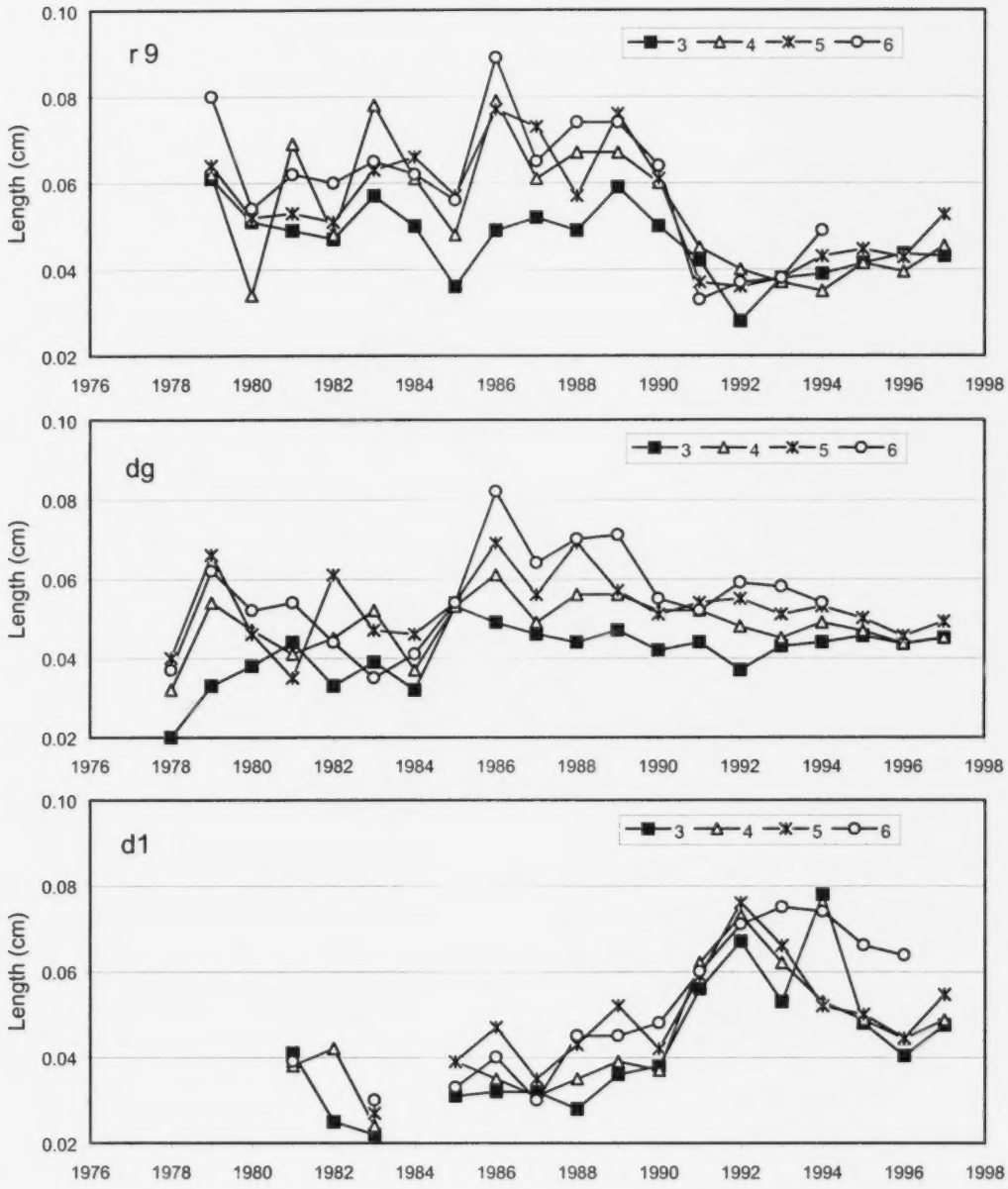

Fig. 5. Mean liver index at ages 3-6 of cod in Divisions 2J, 3K and 3L in 1978-1997, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish in 1995-1997 are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

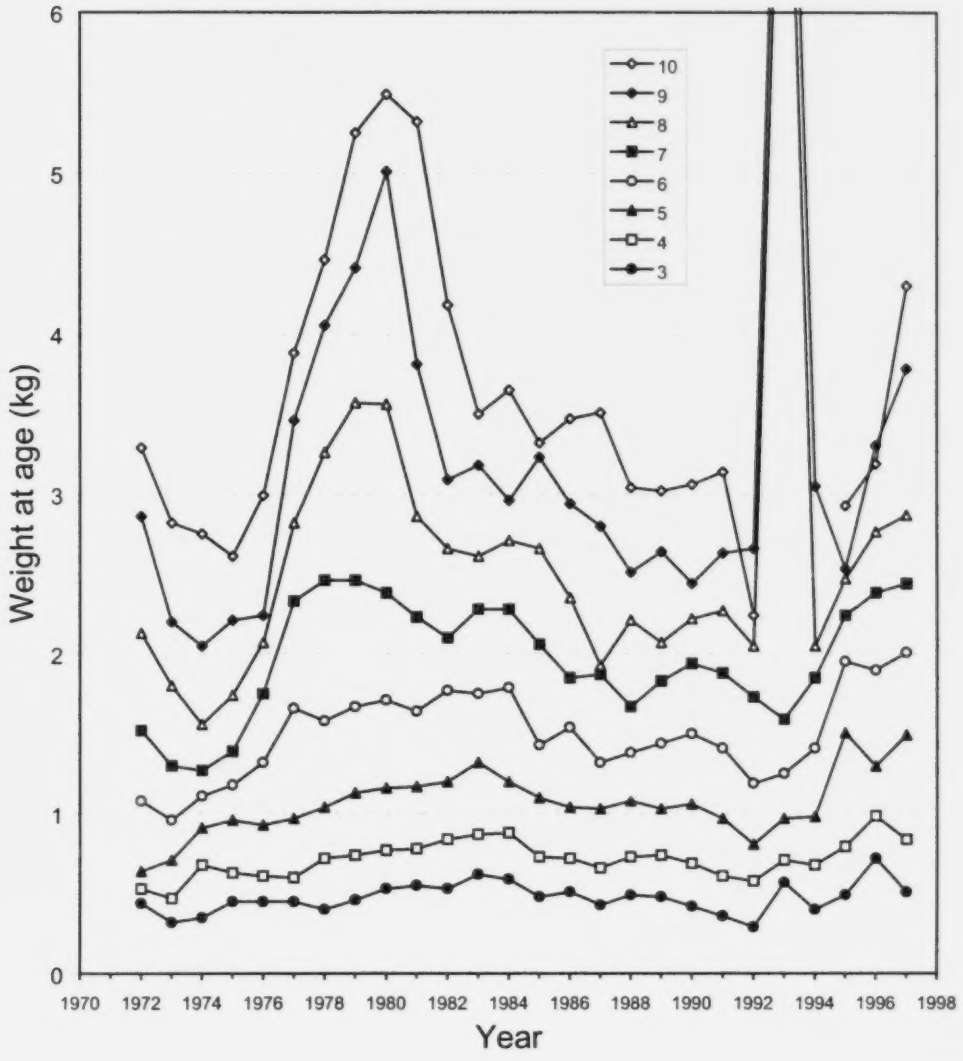

Fig. 6. Mean weight-at-age of cod in divisions 2J, 3K and 3L combined in 1972-1997 as estimated from sampling of the commercial catch (including recreational catch and sentinel surveys).